DELAWARE RIVER BASIN
BRANCH OF HORNBECKS CREEK, PIKE COUNTY

PENNSYLVANIA

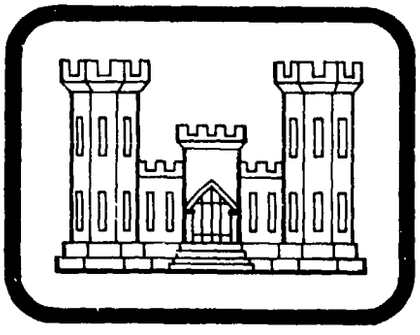
LONG RIDGE DAM

LEVEL II

NDI I.D. NO. PA-01022
PENNDER I.D. NO. 52-185

MARCON, INC.
DACW31-81-C-0015

PHASE I INSPECTION REPORT
NATIONAL DAM INSPECTION PROGRAM



PREPARED FOR

DEPARTMENT OF THE ARMY
Baltimore District, Corps of Engineers
Baltimore, Maryland 21203

PREPARED BY

GAI CONSULTANTS, INC.
570 BEATTY ROAD
MONROEVILLE, PENNSYLVANIA 15146

SEPTEMBER 1981

PREFACE

This report is prepared under guidance contained in the Recommended Guidelines for Safety Inspection of Dams for Phase I Investigations. Copies of these guidelines may be obtained from the Office of Chief of Engineers, Washington, D.C. 20314. The purpose of a Phase I investigation is to identify expeditiously those dams which may pose hazards to human life or property. The assessment of the general condition of the dam is based upon available data and visual inspections. Detailed investigation and analyses involving topographic mapping, subsurface investigations, testing, and detailed computational evaluations are beyond the scope of a Phase I investigation; however, the investigation is intended to identify any need for such studies.

In reviewing this report, it should be realized that the reported condition of the dam is based on observations of field conditions at the time of inspection along with data available to the inspection team.

It is important to note that the condition of a dam depends on numerous and constantly changing internal and external conditions, and is evolutionary in nature. It would be incorrect to assume that the present condition of the dam will continue to represent the condition of the dam at some point in the future. Only through frequent inspections can unsafe conditions be detected and only through continued care and maintenance can these conditions be prevented or corrected.

Phase I inspections are not intended to provide detailed hydrologic and hydraulic analyses. In accordance with the established guidelines, the Spillway Design Flood is based on the estimated Probable Maximum Flood (greatest reasonably possible storm runoff) for the region, or fractions thereof. The Spillway Design Flood provides a measure of relative spillway capacity and serves as an aid in determining the need for more detailed hydrologic and hydraulic studies, considering the size of the dam, its general condition, and the downstream damage potential.

Breach analyses are performed, when necessary, to provide data to assess the potential for downstream damage and possible loss of life. The results are based on specific theoretical scenarios peculiar to the analysis of a particular dam and are not applicable to other related studies such as those conducted under the Federal Flood Insurance Program.

PHASE I INSPECTION REPORT
NATIONAL DAM INSPECTION PROGRAM

ABSTRACT

Long Ridge Dam: NDI I. D. No. PA-01022

Owner	Marcon, Inc.
State Located:	Pennsylvania (PennDER I. D. No. 52-185)
County Located:	Pike
Stream:	Branch of Hornbecks Creek
Inspection Date:	19 May 1981
Inspection Team:	GAI Consultants, Inc. 570 Beatty Road Monroeville, Pennsylvania 15146

Based on a visual inspection, operational history and hydrologic/hydraulic analysis, the dam is considered to be in fair condition.

The size classification of the facility is small and the hazard classification is considered to be high. In accordance with the recommended guidelines, the Spillway Design Flood (SDF) ranges between the 1/2 PMF (Probable Maximum Flood) and the PMF. Since the facility is classified near the lower bounds of the small category, the SDF is considered to be the 1/2 PMF. Results of the hydrologic and hydraulic analysis indicate the facility is capable of accommodating a 1/2 PMF event. Specifically, the facility will pass and/or store about 65 percent of the PMF prior to embankment overtopping. Consequently, the spillway is considered hydraulically adequate.

It is noted that the spillway, as constructed, is considered to be deficient. The evaluation of its hydraulic adequacy is based upon the assumption that the channel is adequately protected against erosion such that its service cannot threaten the structural integrity of the embankment.

It is recommended that the owner immediately:

a. Provide additional interim erosion protection along the entire spillway channel until a more formal spillway assessment is completed.

b. Retain the services of a registered professional engineer, experienced in dam design, to evaluate the existing spillway and prepare recommendations necessary to remedy its current deficient condition.

Long Ridge Dam: NDI I.D. No. PA-01022

c. Develop a formal warning system for the notification of downstream inhabitants should hazardous embankment conditions develop. Included in the plan should be provisions for around-the-clock surveillance of the facility during periods of unusually heavy precipitation.

d. Provide a means of controlling flow through the outlet conduit at its inlet end or provide an emergency plan for blocking the intake in the event that emergency conditions develop within the conduit.

e. Repair the minor erosion along the upstream embankment face and provide additional riprap slope protection where necessary.

f. Continue to observe, in all future inspections, the seepage and swampy conditions between the outlet conduit and left abutment, noting any turbidity and/or changes in rate of flow.

g. Develop formal manuals of operation and maintenance to ensure the continued proper care and operation of the facility.

GAI Consultants, Inc.

Bernard M. Mihalcin

Bernard M. Mihalcin, P.E.

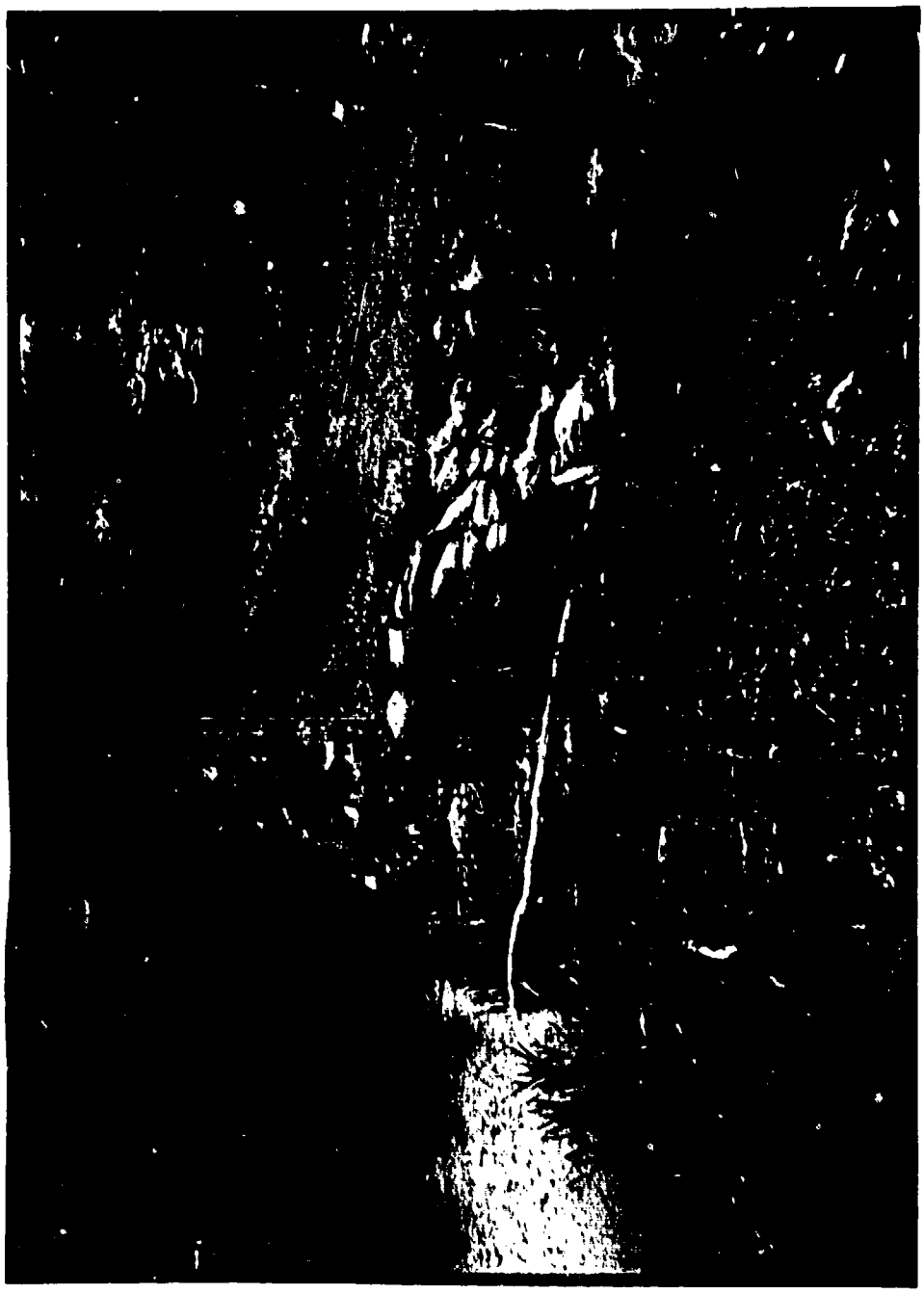
Date 10 Sept 1981

Approved by:

James W. Peck
Colonel, Corps of Engineers
Commander and District Engineer

Date 18 Sep 1981

COMMONWEALTH OF PENNSYLVANIA
REGISTERED PROFESSIONAL
BERNARD M. MIHALCIN
ENGINEER
20371-E



OVERVIEW PHOTOGRAPH

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NATIONAL DAM INSPECTION PROGRAM
LONG RIDGE DAM
NDI NO. PA-01022, PENNDER NO. 52-185

SECTION 1
GENERAL INFORMATION

1.0 Authority

The Dam Inspection Act, Public Law 92-367, authorized the Secretary of the Army, through the Corps of Engineers, to initiate a program of inspection of dams throughout the United States.

1.1 Purpose.

The purpose is to determine if the dam constitutes a hazard to human life or property.

1.2 Description of Project.

a. Dam and Appurtenances. Long Ridge Dam is a 12-foot high, homogeneous earth embankment approximately 350 feet long, including spillway. The facility is constructed with a small, uncontrolled, trapezoidal shaped spillway cut through the embankment near the right abutment. The spillway channel is partially rock lined, but, has no regulating weir. Drawdown capacity is provided by a 12-inch diameter steel conduit located about 100 feet left of the spillway. Flows through the conduit are manually controlled at the outlet by means of a 10-inch diameter gate valve.

b. Location. Long Ridge Dam is located on a branch of Hornbecks Creek in Delaware Township, Pike County, Pennsylvania, approximately five miles west of U.S. Route 209. The facility is located about 3,400 feet northwest of Wild Acres Lake and about 2,600 feet upstream of Rickards Lake. The dam, reservoir and watershed are contained within the Lake Maskenozha, Pennsylvania-New Jersey, 7.5 minute U.S.G.S. topographic quadrangle (see Figure 1, Appendix E). The coordinates of the dam are N41° 13.3' and W74° 56.8'.

c. Size Classification. Small (12 feet high, 53 acre-feet storage capacity at top of dam).

d. Hazard Classification. High (see Section 3.1.e).

e. Ownership. Marcon, Inc.
155 Willowbrook Boulevard
P. O. Box 460
Wayne, New Jersey 07470
Attn: Joseph J. Marone
Vice President

f. Purpose. Recreation.

g. Historical Data. PennDER files contain no information relative to the history of Long Ridge Dam. The owner's representative, Leonard Tusar of Monroe Engineering, Inc. (subsidiary of Marcon, Inc.), stated during the inspection that the dam was constructed sometime around 1973. Joseph D. Sincavage, a former employee of Monroe Engineering, Inc., was reported to have been the principal designer of the facility. No major modifications have been made to the structure since its completion.

1.3 Pertinent Data.

a. Drainage Area (square miles). 0.1

b. Discharge at Dam Site.

Discharge Capacity of Outlet Conduit - Discharge curves are not available.

Discharge Capacity of Spillway at Maximum Pool ≅ 190 cfs (see Appendix D, Sheet 7).

c. Elevations (feet above mean sea level). The following elevations were obtained from available drawings and through field measurements based on the elevation of normal pool at 1195.0 feet (see Appendix D, Sheet 1 and Appendix E, Figure 2).

Top of Dam	1198.0 (design). 1197.1 (field).
Maximum Design Pool	Not known.
Maximum Pool of Record	Not known.
Normal Pool	1195.0 (assumed datum).
Spillway Crest	1195.0
Upstream Inlet Invert	1190.0 (design).
Downstream Outlet Invert	1189.0 (design). 1185.2 (field).
Maximum Tailwater	Not known.
Streambed at Dam Centerline	Not known.

d. Reservoir Length (feet).

Top of Dam	2200
Normal Pool	2100

e. Storage (acre-feet).

Top of Dam	53
Normal Pool	30

f. Reservoir Surface (acres).

Top of Dam	13
Normal Pool	9

g. Dam.

Type	Homogeneous earth.
Length	310 feet (excluding spillway).
Height	12 feet (field measured: embankment crest to downstream invert of outlet conduit).
Top Width	5 feet (design). 8 feet (field).
Upstream Slope	2H:1V (design). 2H:1V (field).
Downstream Slope	2H:1V (design). 3H:1V (field).
Zoning	Homogeneous earth (see Figure 2).
Impervious Core	None indicated.
Cutoff	Figure 2 indicates a 3-foot by 6-foot, rectangular cutoff along the embankment centerline was incorporated into the embankment design.
Grout Curtain	None indicated.

h. Diversion Canal and Regulating Tunnels. None.

i. Spillway.

Type	Uncontrolled, trapezoidal shaped, partially rock lined earth channel cut through the embankment approximately 75 feet from the right abutment. No regulating weir. Discharges are regulated by channel slope.

Crest Elevation	1195.0 Feet
Crest Length	Trapezoidal shape. 10-foot base width; 40-foot top width.

j. Outlet Conduit

Type	12-inch diameter steel conduit.
Length	42 feet (see Figure 2).
Closure and Regulating Facilities	Manually controlled at the outlet by means of a 10-inch diameter gate valve.
Access	Control mechanism is accessible by foot along the downstream embankment toe.

SECTION 2

ENGINEERING DATA

2.1 Design.

a. Design Data Availability and Sources. No design reports, calculations, miscellaneous design data, correspondence, state inspection reports, or as-built construction drawings are available from either the owner or PennDER. A single design drawing, dated 1972, was provided to the inspection team by Monroe Engineering, Inc., and has been included in Appendix E of this report (see Figure 2).

b. Design Features.

1. Embankment. Based primarily on visual observations and field measurements, and with respect to the information detailed in Figure 2, general statements can be made regarding the embankment design. The dam is a 12-foot high, 350-foot long embankment, including spillway. As indicated, the structure is composed of homogeneous earth with a rectangular shaped cutoff located along the embankment centerline. The embankment crest and slopes are grass covered. Figure 2 roughly depicts the structure in both plan and cross section. It is noted, however, that the dimensions illustrated in the figure do not consistently correlate with those gathered by the inspection team. Field measurements indicate the upstream and downstream embankment faces are sloped at 2H:1V and 3H:1V, respectively, and the embankment crest is roughly eight feet wide. Some rock slope protection has been provided at the water line along the upstream embankment face (see Photograph 4).

2. Appurtenant Structures.

a) Spillway. The spillway is an uncontrolled, trapezoidal shaped, earth channel cut through the embankment approximately 75 feet from the right abutment. The spillway has no regulating weir or well defined control section. Therefore, discharges are regulated strictly by the channel slope. Figure 2 indicates the spillway was originally designed to be 20 feet wide at the base with 1H:1V side slopes. Field measurements indicate, however, the base width to be 10 feet and top width to be 40 feet. In addition, the entire channel is shown as being rock lined.

b) Outlet Conduit. The outlet conduit consists of a 12-inch diameter steel pipe located through the embankment about 100 feet left of the emergency spillway. Figure 2 indicates the conduit has a trash screen located at the inlet and is manually controlled at the outlet by means of a 10-inch diameter gate valve.

c. Specific Design Data and Criteria. No design data or information relative to design procedures are available other than Figure 2.

2.2 Construction Records.

No construction records are available for the facility.

2.3 Operational Records.

No records of the day-to-day operation of the facility are maintained.

2.4 Other Investigations.

There are no available records concerning formal studies or investigations of Long Ridge Dam.

2.5 Evaluation.

There is no formal information available relative to the design and construction of this facility other than that contained in Figure 2. The embankment design, based solely on external appearances, generally conforms to the criteria established in modern engineering practice. The spillway, on the other hand, is cut directly through the embankment, but, is not lined with non-erodible material. This is considered to be a significant design deficiency that potentially threatens the stability of the entire structure (see Section 6.1.b.1).

SECTION 3

VISUAL INSPECTION

3.1 Observations.

a. General. The general appearance of the facility suggests the dam and its appurtenances are in fair condition.

b. Embankment. Observations made during the visual inspection reveal the embankment is generally well maintained and presently in good condition (see Photograph 1). No evidence of seepage through the downstream embankment face, sloughing, animal burrows, or excess embankment settlement was noted. Minor seepage (≅1/2 gpm) was encountered along the contact between the left abutment and downstream embankment face (see Photograph 2). The seepage has contributed to a swampy area that extends along the downstream embankment toe to the left of the outlet conduit. Field measurements indicate the seepage emanates near the left abutment at an elevation about two feet below normal pool. Minor erosion from wave action was observed along the upstream embankment face between the spillway and left abutment where the riprap appears inadequate. The erosion is not, however, considered significant at present (see Photographs 3 and 4).

c. Appurtenant Structures.

1. Spillway. The appearance of the spillway suggests it to be in fair condition. The channel lacks clear definition, particularly at its entrance, and appears somewhat obstructed by weeds and debris. Erosion protection along the channel is discontinuous, although rock covers most of the channel from the entrance to its upper portion along the downstream embankment face. The lower portion of the channel is essentially unprotected (see Photographs 1 and 7); however, no signs of significant erosion were observed.

2. Outlet Conduit. The only visible section of the outlet conduit is its discharge end and control mechanism situated along the downstream embankment toe (see Photograph 8). The control mechanism was operated in the presence of the inspection team and found to be functional. No means is presently available for controlling flow through the conduit at its inlet.

d. Reservoir Area. The general area surrounding the reservoir is composed of heavily forested slopes that are gentle to moderate to the east and steep to the west. The watershed is primarily undeveloped at present. No signs of slope distress were observed.

e. Downstream Channel. Discharges from Long Ridge Dam flow through a steep, narrow and heavily forested valley. The channel reach is about 2,600 feet long between Long Ridge Dam and the inlet

to Rickards Lake. Three or four dwellings, housing as many as 20 persons, are located within 500 feet of the inlet to Rickards Lake and are situated sufficiently near the stream to possibly be affected by the floodwaters resulting from a breach of Long Ridge Dam. Consequently, the hazard classification of the facility is considered to be high.

3.2 Evaluation.

The overall appearance of the facility suggests it to be generally well maintained and in fair condition. The spillway design is considered to be deficient and requires further evaluation. In the meantime, the present spillway channel should be completely lined with rock in order to provide interim erosion resistance. Additional riprap protection should also be provided along the upstream embankment face at apparent eroded areas. The seepage and swampy conditions at the embankment-left abutment contact and along the downstream embankment toe should be observed and noted in all future inspections. Outlet conduit control is presently provided at the discharge end only and requires either modification or a plan to control flow at the inlet end should emergency conditions develop within the conduit.

SECTION 4

OPERATIONAL PROCEDURES

4.1 Normal Operating Procedure.

Long Ridge Dam is essentially a self-regulating facility. Excess inflow is automatically discharged through the uncontrolled spillway. Under normal operating conditions the outlet conduit is closed. The outlet conduit control mechanism is not operated on a regular basis; however, it was demonstrated to be functional in the presence of the inspection team. No formal operations manual is available.

4.2 Maintenance of Dam.

The facility is, for the most part, well maintained, but, on an unscheduled basis. Swampy conditions characterize the area along the downstream embankment toe between the outlet conduit and left abutment. No formal maintenance manual is available.

4.3 Maintenance of Operating Facilities.

The outlet conduit control mechanism is presently functional; however, it is not specifically maintained or operated on a regular routine basis.

4.4 Warning System.

No formal warning system is presently in effect.

4.5 Evaluation.

The general appearance of the facility indicates it to be well maintained. No formal program of regular routine maintenance has been established; however, formal manuals of operations and maintenance are recommended to ensure continued proper care of the facility. Incorporated into these manuals should be a formal warning system for the protection of downstream inhabitants. The system should include provisions for around-the-clock surveillance of the facility during periods of unusually heavy precipitation.

SECTION 5

HYDROLOGIC/HYDRAULIC EVALUATION

5.1 Design Data.

No formal design reports, calculations, or miscellaneous design data are available for the facility.

5.2 Experience Data.

Daily records of reservoir levels and/or spillway discharges are not available.

5.3 Visual Observations.

The spillway, as constructed, is considered deficient. In its present condition, it does not appear adequately protected against erosion. Consequently, there is doubt as to whether or not it could function adequately during a major flood event without detrimentally affecting the embankment structure.

5.4 Method of Analysis.

The facility has been analyzed in accordance with the procedures and guidelines established by the U. S. Army, Corps of Engineers, Baltimore District, for Phase I hydrologic and hydraulic evaluations. The analysis has been performed utilizing a modified version of the HEC-1 program developed by the U. S. Army, Corps of Engineers, Hydrologic Engineering Center, Davis, California. Analytical capabilities of the program are briefly outlined in the preface contained in Appendix D.

5.5 Summary of Analysis.

a. Spillway Design Flood (SDF). In accordance with the procedures and guidelines contained in the National Guidelines for Safety Inspection of Dams for Phase I Investigations, the Spillway Design Flood (SDF) for Long Ridge Dam ranges between the 1/2 PMF (Probable Maximum Flood) and the PMF. This classification is based on the relative size of the dam (small) and the potential hazard of dam failure to downstream developments (high). Since the facility is classified near the lower bounds of the small category, the SDF for the facility is considered to be the 1/2 PMF.

b. Results of Analysis. Long Ridge Dam was evaluated under normal operating conditions. That is, the reservoir was initially at its normal pool or spillway crest elevation of 1195.0 feet, with the spillway discharging freely. The outlet conduit was assumed to

be non-functional for the purpose of analysis, since the flow capacity of the conduit is not such that it would significantly increase the total discharge capabilities of the facility. The spillway consists of an uncontrolled, trapezoidal shaped, partially rock lined channel cut through the embankment near its right abutment. The channel was assumed to be non-erodible for the purpose of analysis. All pertinent engineering calculations relative to the evaluation of Long Ridge Dam are provided in Appendix D.

Overtopping analysis (using the modified HEC-1 computer program) indicated that the discharge/storage capacity of Long Ridge Dam can accommodate storms in excess of the 1/2 PMF (SDF), or about 65 percent of the PMF, prior to embankment overtopping. The 1/2 PMF peak inflow of approximately 210 cfs was attenuated by the discharge/storage capabilities of the dam and reservoir, such that the resulting peak outflow was about 140 cfs. The maximum water surface elevation in the reservoir under 1/2 PMF conditions was about 1196.8 feet, or 0.3 foot below the top of the dam (Summary Input/Output Sheets, Sheets B and C).

5.6 Spillway Adequacy.

Long Ridge Dam was found to be capable of accommodating storms in excess of its SDF (the 1/2 PMF), and therefore, its spillway is considered to be hydraulically adequate.

SECTION 6

EVALUATION OF STRUCTURAL INTEGRITY

6.1 Visual Observations.

a. Embankment. The embankment is well maintained and in good condition. Based on visual observations, it can be seen that the embankment is constructed to dimensions that generally conform to modern design criteria. Erosion observed along the upstream embankment face is considered to be minor, but, requires remedial attention. The deficiency is the result of inadequate slope protection along portions of the upstream embankment face. Repairs to the eroded areas should be made to restore the slope to its original shape, upon which, additional riprap should be placed. The seepage and swampy conditions observed between the outlet conduit and left abutment are also considered to be minor at present. Nevertheless, the seepage should be observed in all future inspections, noting any turbidity and/or changes in rate of flow.

b. Appurtenant Structures.

1. Spillway. The spillway, as constructed, is considered deficient. Modern engineering practice typically places excavated spillways in one of the abutments adjacent to, but separate from, the embankment. The purpose is to cut the spillway channel through material which is non-erodible (i.e. erosion resistant rock). If non-erodible material is not present, the spillway channel is sometimes rock lined. Rock lined spillway cuts are expected to sustain some erosion damage under near maximum discharges. However, since they are constructed away from the embankment, any such damage can be subsequently repaired and does not threaten the stability of the impounding structure. Spillways cut through the embankment, as in the case of Long Ridge Dam, cannot be designed to sustain any erosion damage due to the potential for failure of the impounding structure itself. Consequently, they are typically lined with non-erodible material such as concrete. The spillway at Long Ridge Dam is thus considered to be inadequately lined, highly erodible, and potentially threatening to the stability of the embankment during significant flooding events. The condition should be evaluated by a registered professional engineer experienced in dam design and remedial recommendations prepared as necessary.

2. Outlet Conduit. The outlet conduit is considered to be in good condition. The control mechanism located at its discharge end was observed by the inspection team to be functional. Provisions should be made to either control flow from the inlet or effectively block the intake so that flow can be halted in the event a leak or rupture of the conduit occurs beneath the embankment, which could lead to piping and eventual embankment failure.

6.2 Design and Construction Techniques.

No information is available that details the methods of design and/or construction.

6.3 Past Performance.

No records relative to the performance history of the facility are available. The owner's representative stated, however, that to his knowledge the embankment has never been overtopped on either side of the spillway.

6.4 Seismic Stability.

The dam is located in Seismic Zone No. 1 and may be subject to minor earthquake induced dynamic forces. It is believed that the facility, as constructed, can withstand the expected dynamic forces; however, no calculations and/or investigations were performed to confirm this opinion.

SECTION 7

ASSESSMENT AND RECOMMENDATIONS FOR REMEDIAL MEASURES

7.1 Dam Assessment.

a. Safety. The results of this investigation indicate the facility is in fair condition.

The size classification of the facility is small and the hazard classification is considered to be high. In accordance with the recommended guidelines, the Spillway Design Flood (SDF) ranges between the 1/2 PMF (Probable Maximum Flood) and the PMF. Since the facility is classified near the lower bounds of the small category, the SDF is considered to be the 1/2 PMF. Results of the hydrologic and hydraulic analysis indicate the facility is capable of accommodating a 1/2 PMF event. Specifically, the facility will pass and/or store about 65 percent of the PMF prior to embankment overtopping. Consequently, the spillway is considered hydraulically adequate.

It is noted that the spillway, as constructed, is considered to be deficient. The evaluation of its hydraulic adequacy is based upon the assumption that the channel is adequately protected against erosion such that its service cannot threaten the structural integrity of the embankment.

b. Adequacy of Information. The available information is considered adequate to make a reasonable Phase I assessment of the facility.

c. Urgency. The recommendations listed below should be implemented immediately.

d. Necessity for Additional Investigations. An additional investigation is deemed necessary to re-evaluate the spillway design.

7.2 Recommendations/Remedial Measures.

It is recommended that the owner immediately:

a. Provide additional interim erosion protection along the entire spillway channel until a more formal spillway assessment is completed.

b. Retain the services of a registered professional engineer, experienced in dam design, to evaluate the present spillway design and prepare recommendations necessary to remedy its present deficient condition.

c. Develop a formal warning system for the notification of downstream inhabitants should hazardous embankment conditions develop. Included in the plan should be provisions for around-the-clock surveillance of the facility during periods of unusually heavy precipitation.

d. Provide a means of controlling flow through the outlet conduit at its inlet end or provide a plan for blocking the intake in the event that emergency conditions develop within the conduit.

e. Repair the minor erosion along the upstream embankment face and provide additional riprap slope protection where necessary.

f. Continue to observe, in all future inspections, the seepage and swampy conditions between the outlet conduit and left abutment, noting any turbidity and/or changes in rate of flow.

g. Develop formal manuals of operations and maintenance to ensure the continued proper care and operation of the facility.

APPENDIX A

VISUAL INSPECTION CHECKLIST AND FIELD SKETCHES

CHECK LIST
VISUAL INSPECTION
PHASE 1

NAME OF DAM Long Ridge Dam STATE Pennsylvania COUNTY Pike

NDI # PA — 01022 PENNDER # 52-185

TYPE OF DAM Earth SIZE Small HAZARD CATEGORY High

DATE(S) INSPECTION 19 May 1981 WEATHER Partly cloudy TEMPERATURE 65° @ 3:00 PM

POOL ELEVATION AT TIME OF INSPECTION 1195.2 feet M.S.L.

TAILWATER AT TIME OF INSPECTION N/A. M.S.L.

INSPECTION PERSONNEL	OWNER REPRESENTATIVES	*OTHERS*
B. M. Mihalcin	Monroe Engineering, Inc.	
D. J. Spaeder	Leonard Tusar - General Manager	
D. L. Bonk		

RECORDED BY D. L. Bonk

EMBANKMENT

ITEM	OBSERVATIONS/REMARKS/RECOMMENDATIONS NDI# PA - 01022
SURFACE CRACKS	None observed.
UNUSUAL MOVEMENT OR CRACKING AT OR BEYOND THE TOE	None observed.
SLOUGHING OR EROSION OF EMBANKMENT AND ABUTMENT SLOPES	Minor erosion evident along the upstream embankment face between the spillway and left abutment.
VERTICAL AND HORIZONTAL ALIGNMENT OF THE CREST	Horizontal - Good. Vertical - Good. (see "Profile of Dam from Field Survey," Appendix A).
RIPRAP FAILURES	Patchy sandstone riprap partially protects the upstream embankment face. Some minor erosion is evident.
JUNCTION OF EMBANKMENT AND ABUTMENT, SPILLWAY AND DAM	Embankment-abutment junctions are in good condition. The spillway is cut through the embankment and lacks adequate erosion protection along its sidewalls. No significant erosion, however, is presently evident at these junctures.

EMBANKMENT

ITEM	OBSERVATIONS/REMARKS/RECOMMENDATIONS NDI# PA- 01022
DAMP AREAS IRREGULAR VEGETATION (LUSH OR DEAD PLANTS)	Grass covered crest and slopes.
ANY NOTICEABLE SEEPAGE	Minor seepage (≈1/2 gpm) was encountered along the contact between the left abutment and downstream embankment face. The seepage has contributed to swampy area that extends along the downstream embankment toe between the outlet conduit and left abutment.
STAFF GAGE AND RECORDER	None.
DRAINS	None observed.

OUTLET WORKS

ITEM	OBSERVATIONS/REMARKS/RECOMMENDATIONS NDI# PA- 01022
INTAKE STRUCTURE	Submerged, not observed.
OUTLET CONDUIT (CRACKING AND SPALLING OF CONCRETE SURFACES)	12-inch diameter steel conduit. Not observed.
OUTLET STRUCTURE	10-inch diameter gate valve located at the discharge end of the outlet conduit. Operated in the presence of the inspection team. Good condition.
OUTLET CHANNEL	Discharges into a natural channel.
GATE(S) AND OPERATIONAL EQUIPMENT	See "Outlet Structure" above.

EMERGENCY SPILLWAY

ITEM	OBSERVATIONS/REMARKS/RECOMMENDATIONS NDI# PA- 01022
TYPE AND CONDITION	Uncontrolled, trapezoidal shaped, earth channel cut through the embankment approximately 75 feet from the right abutment. No regulating weir or well defined control section.
APPROACH CHANNEL	N/A
SPILLWAY CHANNEL AND SIDEWALLS	Rock lined channel at channel entrance and along the upper portion of the downstream embankment face. The lower portion of the channel is essentially unprotected. No signs of significant erosion were observed.
STILLING BASIN PLUNGE POOL	None.
DISCHARGE CHANNEL	Natural channel.
BRIDGE AND PIERS EMERGENCY GATES	None.

SERVICE SPILLWAY

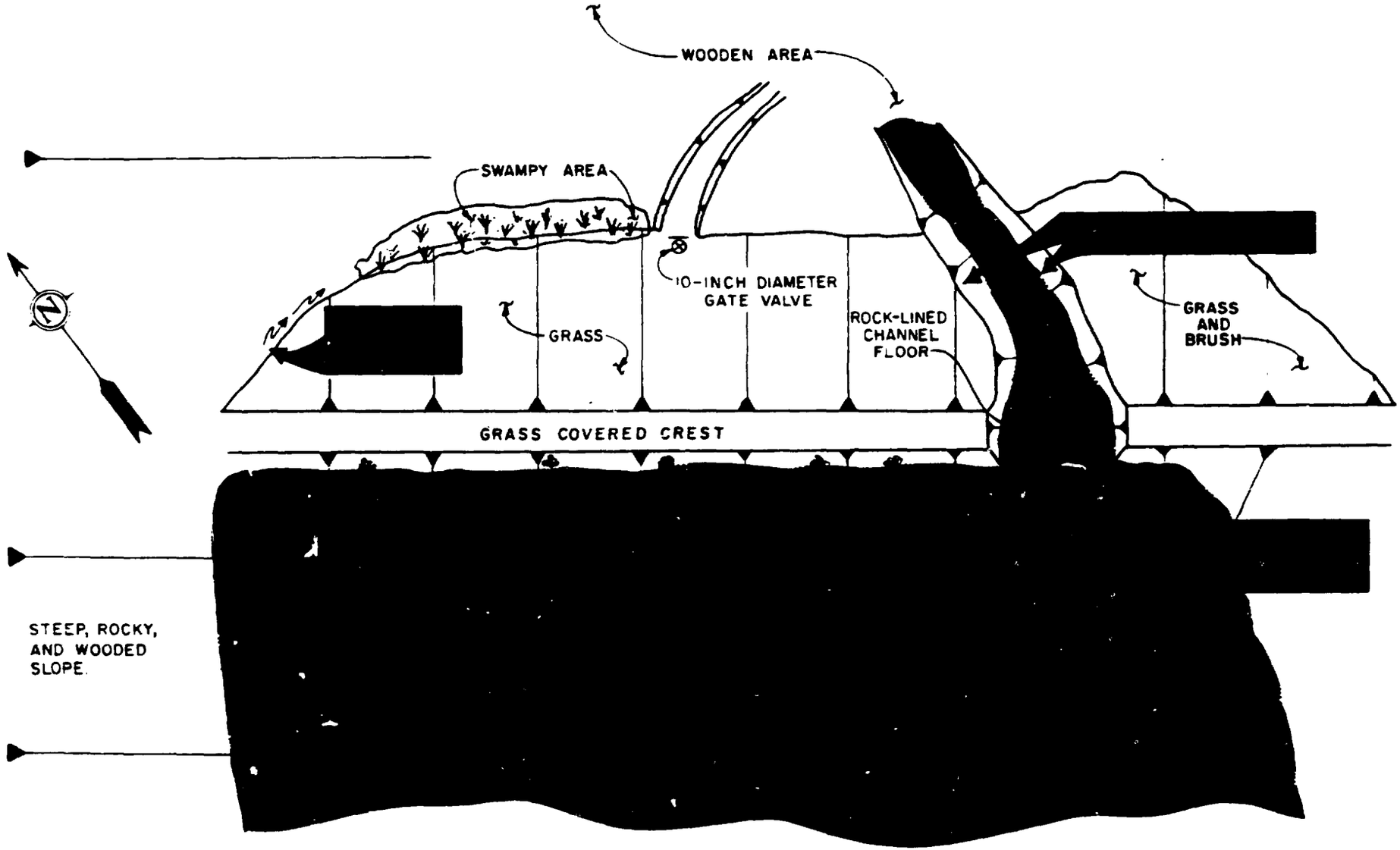
ITEM	OBSERVATIONS/REMARKS/RECOMMENDATIONS NDI# PA - 01022
TYPE AND CONDITION	N/A
APPROACH CHANNEL	N/A
OUTLET STRUCTURE	N/A
DISCHARGE CHANNEL	N/A

INSTRUMENTATION

ITEM	OBSERVATIONS/REMARKS/RECOMMENDATIONS NDI# PA - 01022
MONUMENTATION SURVEYS	None.
OBSERVATION WELLS	None.
WEIRS	None.
PIEZOMETERS	None.
OTHERS	

RESERVOIR AREA AND DOWNSTREAM CHANNEL

ITEM	OBSERVATIONS/REMARKS/RECOMMENDATIONS NDI# PA - 01022
SLOPES: RESERVOIR	The general area surrounding the reservoir is composed of heavily forested slopes that are gentle to moderate to the east and steep to the west. The watershed is primarily undeveloped at present.
SEDIMENTATION	None observed.
DOWNSTREAM CHANNEL (OBSTRUCTIONS, DEBRIS, ETC.)	Discharges into Rickards Lake about 2,600 feet downstream.
SLOPES: CHANNEL VALLEY	Steep, narrow and heavily forested valley between Long Ridge Dam and Rickards Lake.
APPROXIMATE NUMBER OF HOMES AND POPULATION	Three or four dwellings, housing as many as 20 persons, are located within 500 feet of the inlet to Rickards Lake and are situated sufficiently near the stream to possibly be affected by the floodwater resulting from a breach of Long Ridge Dam.

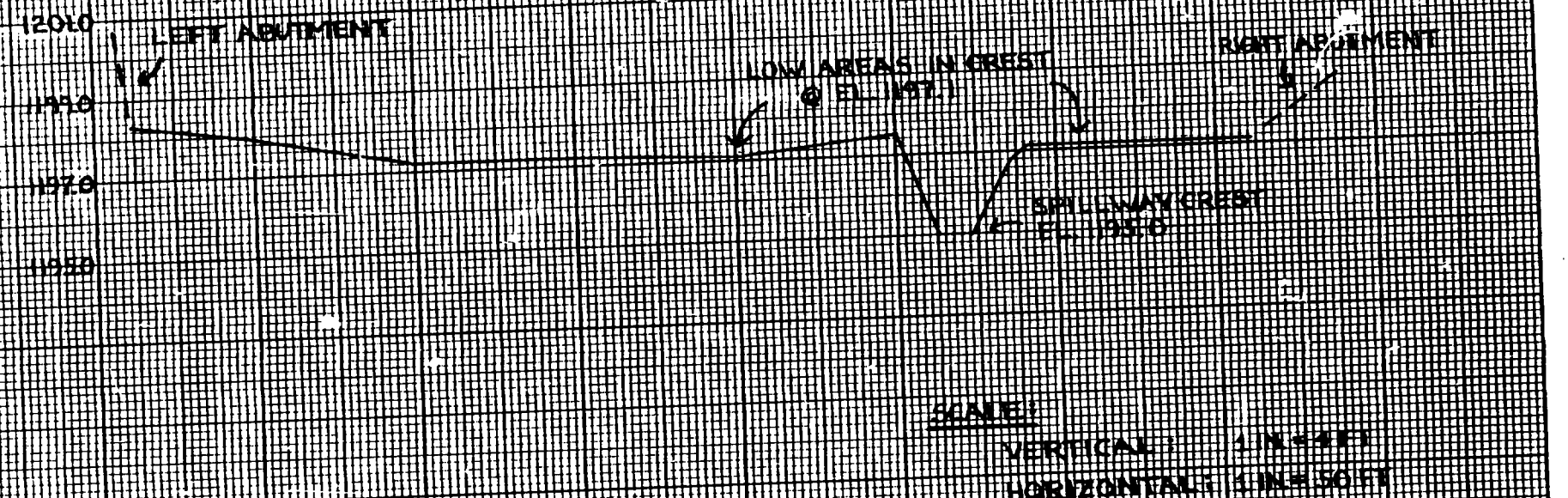


LONG RIDGE DAM
GENERAL PLAN - FIELD INSPECTION NOTES

NDEI # PA-04022

LONG RIDGE DAM

PROFILE OF DAM CREST FROM FIELD SURVEY



SCALE:
VERTICAL: 1 IN = 4 FT
HORIZONTAL: 1 IN = 50 FT

SUBJECT LONG RIDGE DAM
BY J.J.S. DATE 6-25-81 SHEET NO. ___ OF ___
CHKD. BY ___ DATE ___ PROJECT NO. 80-129-022

APPENDIX B

ENGINEERING DATA CHECKLIST

CHECK LIST
ENGINEERING DATA
PHASE I

NAME OF DAM Long Ridge Dam

ITEM	REMARKS NDI# PA- 01022
PERSONS INTERVIEWED AND TITLE	Monroe Engineering, Inc. (Sudsidiary of Marcon, Inc.) Leonard Tusar - General Manager
REGIONAL VICINITY MAP	See Figure 1, Appendix E.
CONSTRUCTION HISTORY	Designed by Joseph D. Sincavage, a former employee of Monroe Engineering, Inc. Constructed around 1973.
AVAILABLE DRAWINGS	Drawing dated December 1972 was made available to the inspection team by the owner. Drawing depicts the facility both in plan and cross-section (see Figure 2, Appendix E).
TYPICAL DAM SECTIONS	See Figure 2, Appendix E.
OUTLETS: PLAN DETAILS DISCHARGE RATINGS	See Figure 2, Appendix E. Discharge rating curves are not available.

CHECK LIST
ENGINEERING DATA
PHASE I
(CONTINUED)

ITEM	REMARKS	NDI# PA - 01022
SPILLWAY: PLAN SECTION DETAILS	See Figure 2, Appendix E.	
OPERATING EQUIP- MENT PLANS AND DETAILS	See Figure 2, Appendix E.	
DESIGN REPORTS	None available.	
GEOLOGY REPORTS	None available.	
DESIGN COMPUTATIONS: HYDROLOGY AND HYDRAULICS STABILITY ANALYSES SEEPAGE ANALYSES	None available.	
MATERIAL INVESTIGATIONS: BORING RECORDS LABORATORY TESTING FIELD TESTING	None available.	

CHECK LIST
ENGINEERING DATA
PHASE I
(CONTINUED)

ITEM	REMARKS	NDI# PA - 01022
BORROW SOURCES	Within reservoir.	
POST CONSTRUCTION DAM SURVEYS	None.	
POST CONSTRUCTION ENGINEERING STUDIES AND REPORTS	None.	
HIGH POOL RECORDS	Not known. Dam reportedly has never been overtopped.	
MONITORING SYSTEMS	None.	
MODIFICATIONS	None.	

CHECK LIST
ENGINEERING DATA
PHASE I
(CONTINUED)

ITEM	REMARKS NDI# PA - 01022
PRIOR ACCIDENTS OR FAILURES	None.
MAINTENANCE: RECORDS MANUAL	No records or manual available.
OPERATION: RECORDS MANUAL	No records or manual available.
OPERATIONAL PROCEDURES	Self-regulating.
WARNING SYSTEM AND/OR COMMUNICATION FACILITIES	No formal warning system is presently in effect.
MISCELLANEOUS	

CHECK LIST
HYDROLOGIC AND HYDRAULIC
ENGINEERING DATA

NDI ID # PA-01022
PENNDER ID # 52-185

SIZE OF DRAINAGE AREA: 0.1 square mile.

ELEVATION TOP NORMAL POOL: 1195.0 STORAGE CAPACITY: 30 acre-feet.

ELEVATION TOP FLOOD CONTROL POOL: - STORAGE CAPACITY: -

ELEVATION MAXIMUM DESIGN POOL: - STORAGE CAPACITY: -

ELEVATION TOP DAM: 1197.1 STORAGE CAPACITY: 53 acre-feet.

SPILLWAY DATA

CREST ELEVATION: 1195.0 feet.

TYPE: Uncontrolled, trapezoidal shaped, earth channel cut through embankment.

CREST LENGTH: 10 feet (base); 40 feet (top).

CHANNEL LENGTH: Approximately 40 feet.

SPILLOVER LOCATION: About 75 feet from right abutment.

NUMBER AND TYPE OF GATES: None.

OUTLET WORKS

TYPE: 12-inch diameter steel conduit.

LOCATION: About 100 feet left of spillway.

ENTRANCE INVERTS: 1190.0 (design).

EXIT INVERTS: 1189.0 (design); 1185.2 (field).

EMERGENCY DRAWDOWN FACILITIES: 10-inch diameter gate valve located at the discharge end.

HYDROMETEOROLOGICAL GAGES

TYPE: None.

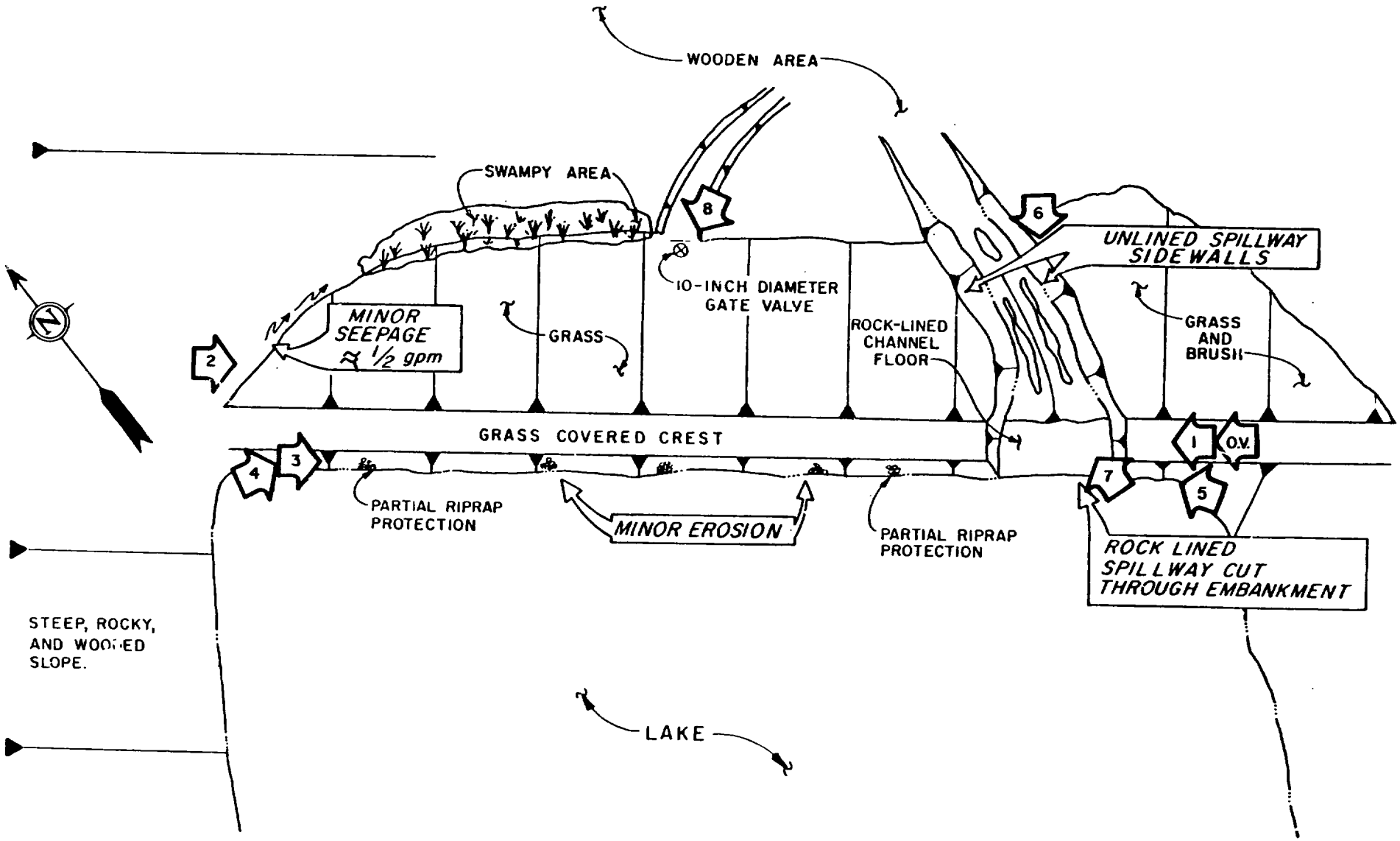
LOCATION: -

RECORDS: -

MAXIMUM NON-DAMAGING DISCHARGE: Not known.

APPENDIX C

PHOTOGRAPHS



LONG RIDGE DAM
GENERAL PLAN - FIELD INSPECTION NOTES

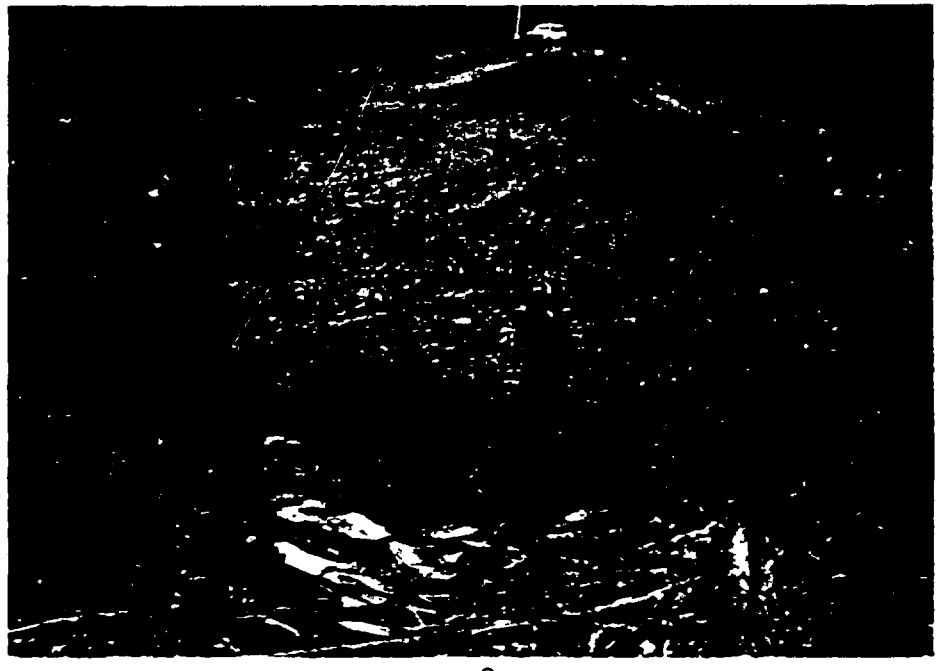
PHOTOGRAPH 1 Overview of the embankment as seen from the right abutment.

PHOTOGRAPH 2 View of the downstream embankment face as seen from the left abutment. The inspection team member in the view is standing at the top of the seepage source encountered along embankment-left abutment contact.

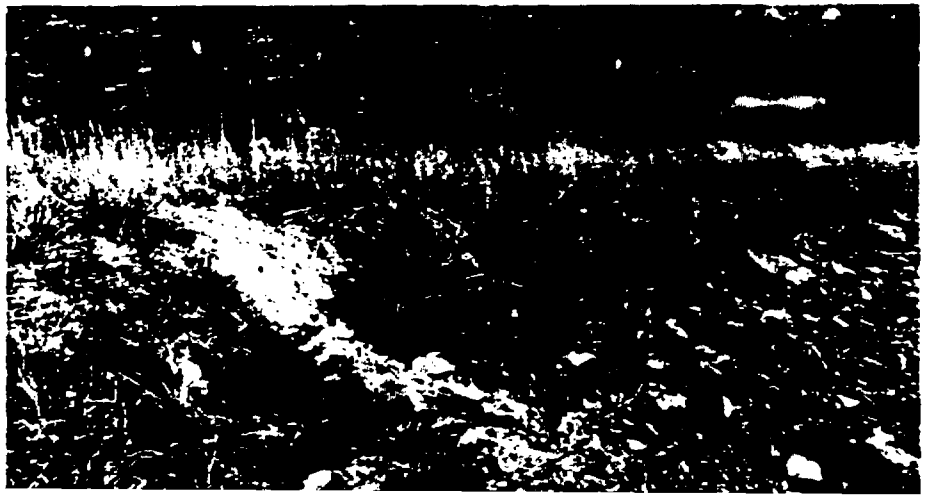
PHOTOGRAPH 3 View of the upstream embankment face as seen from the left abutment.

PHOTOGRAPH 4 Close-up view of patchy riprap along the upstream embankment face.

1



2



PHOTOGRAPH 5 View of the entrance to the spillway situated near the right abutment.

PHOTOGRAPH 6 View of the spillway discharge channel looking upstream from along the downstream embankment toe.

PHOTOGRAPH 7 View of the spillway discharge channel looking downstream.

PHOTOGRAPH 8 Close-up view of the outlet conduit control mechanism situated at the discharge end of the conduit which is located along the downstream embankment toe.

5

6

APPENDIX D

HYDROLOGIC AND HYDRAULIC ANALYSES

PREFACE

The modified HEC-1 program is capable of performing two basic types of hydrologic analyses: 1) the evaluation of the overtopping potential of the dam; and 2) the estimation of the downstream hydrologic-hydraulic consequences resulting from assumed structural failures of the dam. Briefly, the computational procedures typically used in the dam overtopping analysis are as follows:

a. Development of an inflow hydrograph(s) to the reservoir.

b. Routing of the inflow hydrograph(s) through the reservoir to determine if the event(s) analyzed would overtop the dam.

c. Routing of the outflow hydrograph(s) from the reservoir to desired downstream locations. The results provide the peak discharge(s), time(s) of occurrence the peak discharge(s), and the maximum stage(s) of each routed hydrograph at the downstream end of each reach.

The evaluation of the hydrologic-hydraulic consequences resulting from an assumed structural failure (breach) of the dam is typically performed as shown below.

a. Development of an inflow hydrograph(s) to the reservoir.

b. Routing of the inflow hydrograph(s) through the reservoir.

c. Development of a failure hydrograph(s) based on specified breach criteria and normal reservoir outflow.

d. Routing of the failure hydrograph(s) to desired downstream locations. The results provide estimates of the peak discharge(s), time(s) to peak and maximum water surface elevation(s) of failure hydrograph(s) for each location.

HYDROLOGY AND HYDRAULIC ANALYSIS
DATA BASE

NAME OF DAM: LONG RIDGE DAM

PROBABLE MAXIMUM PRECIPITATION (PMP) = 22.0 INCHES/24 HOURS (1)

STATION	1	2	3
STATION DESCRIPTION	LONG RIDGE DAM		
DRAINAGE AREA (SQUARE MILES)	0.10		
CUMULATIVE DRAINAGE AREA (SQUARE MILES)	-		
ADJUSTMENT OF PMF FOR DRAINAGE AREA LOCATION (%) (1)	ZONE 1		
6 HOURS	111		
12 HOURS	123		
24 HOURS	133		
48 HOURS	142		
72 HOURS	-		
SNYDER HYDROGRAPH PARAMETERS			
ZONE (2)	1		
C_p (3)	0.45		
C_t (3)	1.23		
L' (MILES) (4)	0.21		
$t_p = (L')^{0.6}$ (HOURS)	0.48		
SPILLWAY DATA			
CREST LENGTH (FEET)	10		
FREEBOARD (FEET)	2.1		

(1) HYDROMETEOROLOGICAL REPORT 33, U.S. ARMY CORPS OF ENGINEERS, 1956.
(2) HYDROLOGIC ZONE DEFINED BY CORPS OF ENGINEERS, BALTIMORE DISTRICT, FOR DETERMINATION OF SNYDER COEFFICIENTS (C_p AND C_t).
(3) SNYDER COEFFICIENTS
(4) L' = LENGTH OF LONGEST WATERCOURSE FROM RESERVOIR INLET TO BASIN DIVIDE.

SUBJECT DAM SAFETY INSPECTION
LONG RIDGE DAM

BY JJS DATE 6-10-81 PROJ. NO. 80-238-022

CHKD. BY DLB DATE 6-24-81 SHEET NO. 1 OF 10

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DAM STATISTICS

HEIGHT OF DAM = 12 FT (FIELD MEASURED: TOP OF DAM TO DOWNSTREAM INVERT OF OUTLET CONDUIT; "TOP OF DAM" HERE AND ON ALL SUBSEQUENT CALCULATION SHEETS REFERS TO THE LOW AREA IN THE EMBANKMENT CREST.)

NORMAL POOL STORAGE CAPACITY = 30 AC-FT (HEC-1)

MAXIMUM POOL STORAGE CAPACITY = 53 AC-FT (HEC-1)
(@ TOP OF DAM)

DRAINAGE AREA = 0.10 SQ. MI. (PLANIMETERED ON USGS TOPO QUAD - LAKE MASKENOZHA, PA)

ELEVATIONS:

TOP OF DAM (DESIGN)	= 1198.0	(FIG. 2)
TOP OF DAM (FIELD)	= 1197.1	
NORMAL POOL	= 1195.0	
SPILLWAY CREST	= 1195.0	(FIG. 2)
UPSTREAM INLET INVERT (DESIGN)	= 1190.0	(FIG. 2)
DOWNSTREAM OUTLET INVERT (DESIGN)	= 1189.0	(FIG. 2)
DOWNSTREAM OUTLET INVERT (FIELD)	= 1185.2	
STREAMBED @ DAM CENTERLINE	= NOT KNOWN	

SUBJECT DAM SAFETY INSPECTION - LONG RIDGE DAM

BY DJS DATE 6-10-81 PROJ. NO. 80-238-022

CHKD. BY DLG DATE 6-24-81 SHEET NO. 2 OF 10

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DAM CLASSIFICATION

DAM SIZE:	SMALL	(REF 1, TABLE 1)
HAZARD CLASSIFICATION:	HIGH	(FIELD OBSERVATION)
REQUIRED SDF:	½ PMF TO PMF	(REF 1, TABLE 3)

HYDROGRAPH PARAMETERS

$C_p = 0.45$

$C_t = 1.23$

(SUPPLIED BY C.O.E., ZONE 1, DELAWARE RIVER BASIN)

LENGTH OF LONGEST WATERCOURSE FROM RESERVOIR INLET TO BASIN DIVIDE:

$L' = 0.21$ MILES

(MEASURED ON USGS TOPO QUAD - LAKE MASKENOZHA)

$$t_p = C_t (L')^{0.6}$$
$$= 1.23 (0.21)^{0.6} = 0.48 \text{ HOURS}$$

NOTE: SINCE L_{ca}, THE LENGTH OF THE LONGEST WATERCOURSE FROM THE DAM TO A POINT OPPOSITE THE BASIN CENTROID, IS LESS THAN THE LENGTH OF THE RESERVOIR, THE ABOVE EQUATION IS USED TO ESTIMATE THE SNYDER STANDARD LAG (AS PER C.O.E., BALTIMORE DISTRICT). HYDROGRAPH VARIABLES USED HERE ARE DEFINED IN REF. 2, IN SECTION ENTITLED "SNYDER SYNTHETIC UNIT HYDROGRAPH."

SUBJECT DAM SAFETY INSPECTION
LONG RIDGE DAM

BY DJS DATE 6-10-81 PROJ. NO. 80-238-022

CHKD. BY DLB DATE 6-24-81 SHEET NO. 3 OF 10

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RESERVOIR STORAGE CAPACITY

Reservoir Surface Areas:

Surface Area (S.A.) at normal pool (El. 1195.0) = 9 acres

S.A. @ El. 1200 = 18 acres

(Planimetered on USGS topo quad - Lake Maskenozha, PA)

S.A. @ top of dam (El. 1197.1) = 12.8 acres
(by linear interpolation)

The "zero storage" or minimum reservoir elevation is assumed to be at approximately the same elevation as the downstream toe of the embankment, at El. 1185.

Elevation - Storage Relationship:

The elevation - storage relationship is computed internally in the HEC-1 program, by use of the conic method, based on the given reservoir surface area and elevation data (see Summary Input / Output sheets).

SUBJECT DAM SAFETY INSPECTION
LONG RIDGE DAM

BY DSS DATE 6-10-81 PROJ. NO. 80-288-022

CHKD. BY DLB DATE 6-24-81 SHEET NO. 4 OF 10

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PMP CALCULATIONS

APPROXIMATE RAINFALL INDEX = 22.0 INCHES
(CORRESPONDING TO A DURATION OF 24 HOURS AND A DRAINAGE AREA OF 200 SQUARE MILES.)

(REF. 3, FIG. 1)

DEPTH - AREA - DURATION ZONE 1 (REF 3, FIG. 1)

- ASSUME DATA CORRESPONDING TO A 10-SQUARE MILE AREA MAY BE APPLIED TO THIS 0.10 - SQUARE MILE BASIN:

DURATION (HRS)	PERCENT OF INDEX RAINFALL
6	111
12	123
24	133
48	142

(REF. 3, FIG. 2)

HOP BROOK FACTOR (ADJUSTMENT FOR BASIN SHAPE AND FOR THE LESSER LIKELIHOOD OF A SEVERE STORM CENTERING OVER A SMALL BASIN) FOR A DRAINAGE AREA OF 0.10 SQUARE MILES IS 0.80.

(REF 4, p. 48)

SUBJECT DAM SAFETY INSPECTION
LONG RIDGE DAM

BY RJS DATE 6-10-81 PROJ. NO. 80-238-022

CHKD. BY DLB DATE 6-24-81 SHEET NO. 5 OF 10

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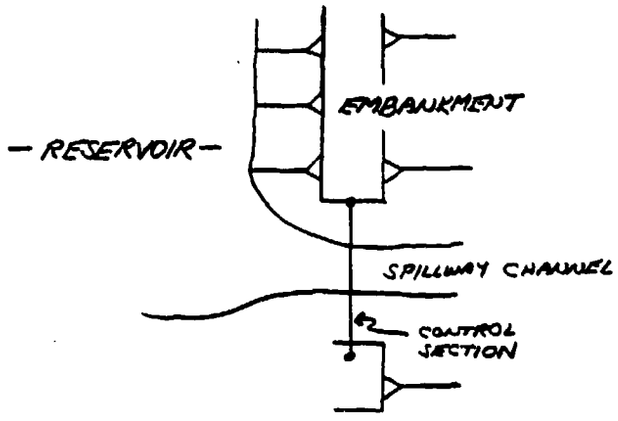
SPILLWAY CAPACITY

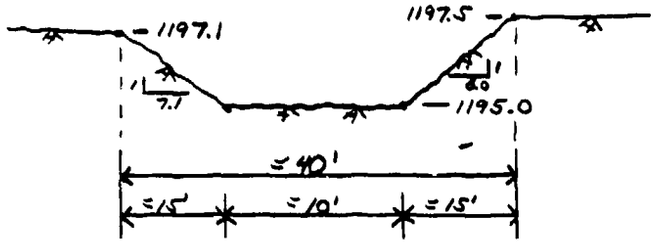
PLAN:



CONTROL SECTION:

(LOOKING UPSTREAM)

APPROXIMATION OF CONTROL SECTION:



(NOT TO SCALE)

- SKETCHES BASED ON FIELD SURVEY.

THE SPILLWAY CONSISTS OF AN UNCONTROLLED, TRAPEZOIDAL SHAPED, PARTIALLY ROCK-LINED CHANNEL CUT THROUGH THE EMBANKMENT NEAR ITS RIGHT ABUTMENT. THE CONTROL SECTION IS LOCATED NEAR THE RESERVOIR OUTLET, AS SHOWN ABOVE.

SUBJECT DAM SAFETY INSPECTION
LONG RIDGE DAM

BY DJS DATE 6-10-81 PROJ. NO. 80-238-022

CHKD. BY DLB DATE 6-24-81 SHEET NO. 6 OF 10

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BASED ON THE ASSUMPTION OF CRITICAL FLOW AT THE CONTROL SECTION,

$$\frac{Q^2 T}{g A^3} = 1.0 \qquad \text{(REF 5, p. 8-7)}$$

WHERE Q = DISCHARGE, IN CFS,
T = TOP WIDTH OF FLOW AREA, IN FT,
g = GRAVITATIONAL ACCELERATION CONSTANT = 32.2 FT/SEC^2,
A = FLOW AREA, IN FT.^{2}

ALSO,

$$Hm = D_c + \frac{D_m}{2}$$

AND $D_m = A/T$ (REF 5, p. 8-8)

WHERE Hm = TOTAL HEAD AT CRITICAL DEPTH, OR MINIMUM SPECIFIC ENERGY, IN FT,
D_c = CRITICAL DEPTH, IN FT,
D_m = MEAN DEPTH OF FLOW AREA, IN FT.

THE RESERVOIR ELEVATION CORRESPONDING TO ANY PARTICULAR DISCHARGE IS THEN $Hm + 1195.0$ (WHERE THE INVERT OF THE CONTROL SECTION = 1195.0). THIS IS BASED ON THE ASSUMPTION OF ZERO-VELOCITY HEAD AT THE RESERVOIR JUST UPSTREAM OF THE CONTROL SECTION, AND NEGLIGIBLE HEAD LOSS TO THE CONTROL SECTION → NO APPROACH LOSSES.

SUBJECT DAM SAFETY INSPECTION
LONG RIDGE DAM

BY DJS DATE 6-10-81 PROJ. NO. 80-238-022

CHKD. BY DLB DATE 6-24-81 SHEET NO. 7 OF 10

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SPILLWAY RATING TABLE:

D_c (FT)	A ① (FT²)	T ② (FT)	D_m ③ (FT)	H_m ④ (FT)	Q ⑤ (CFS)	RESERVOIR ELEVATION ⑥ (FT)	
0.5	6.6	16.6	0.40	0.7	24	1195.7	
1.0	16.6	23.1	0.72	1.4	80	1196.4	
1.5	29.7	29.7	1.00	2.0	169	1197.0	
1.6	32.8	31.0	1.06	2.1	191	1197.1	(TOP OF DAM)
1.9	42.6	34.9	1.22	2.5	267	1197.5	
2.3	57.5	38.8	1.48	3.0	397	1198.0	
2.6	69.4	40.0	1.74	3.5	519	1198.5	
2.9	81.4	40.0	2.04	3.9	659	1198.9	
3.3	97.4	40.0	2.44	4.5	862	1199.5	

① FOR $D_c \leq 2.1$, $A = 10D_c + \frac{7.1}{2}D_c^2 + \frac{6.0}{2}D_c^2 = 10D_c + 6.55D_c^2$
FOR $2.1 \leq D_c \leq 2.5$, $A = 49.9 + 37.6(D_c - 2.1) + 3.0(D_c - 2.1)^2$
FOR $D_c \geq 2.5$, $65.4 + 40(D_c - 2.5)$

② FOR $D_c \leq 2.1$, $10 + 7.1D_c + 6.0D_c = 10 + 13.1D_c$
FOR $2.1 \leq D_c \leq 2.5$, $15 + 10 + 6.0D_c = 25 + 6.3D_c$
FOR $D_c \geq 2.5$, $T = 40$

③ $D_m = A/T$

④ $H_m = D_c + D_m/2$

⑤ $Q = \sqrt{gA^3/T}$

⑥ RESERVOIR ELEVATION $= H_m + 1195.0$

SUBJECT DAM SAFETY INSPECTION
LONG RIDGE DAM

BY DJS DATE 6-11-81 PROJ. NO. 80-238-022

CHKD. BY DCB DATE 6-24-81 SHEET NO. 8 OF 10

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EMBANKMENT RATING CURVE

ASSUME THAT THE EMBANKMENT BEHAVES ESSENTIALLY AS A BROAD-CRESTED WEIR WHEN OVERTOPPING OCCURS. THUS, THE DISCHARGE CAN BE ESTIMATED BY THE RELATIONSHIP

$$Q = CLH^{3/2} \qquad \text{(REF 5, p. 5-23)}$$

WHERE Q = DISCHARGE OVER EMBANKMENT, IN CFS,
L = LENGTH OF EMBANKMENT OVERTOPPED, IN FT,
H = HEAD, IN FT; IN THIS CASE IT IS THE AVERAGE "FLOW AREA WEIGHTED HEAD" ABOVE THE LOW AREA IN THE EMBANKMENT CREST; AND,
C = COEFFICIENT OF DISCHARGE; DEPENDENT UPON THE HEAD AND THE WEIR BREADTH.

LENGTH OF EMBANKMENT INUNDATED VS. RESERVOIR ELEVATION:

ELEVATION (FT)	LENGTH (FT)
1197.1	70
1197.2	110
1197.3	205
1197.5	250
1198.0	295
1199.0	340
1200.0	360

(BASED ON FIELD SURVEY AND USGS TOPO QUAD - LAKE MASKENOZHA, P

SUBJECT DAM SAFETY INSPECTION
LONG RIDGE DAM

BY DJS DATE 6-11-81 PROJ. NO. 80-238-022

CHKD. BY DLG DATE 6-24-81 SHEET NO. 9 OF 10

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ASSUME THAT INCREMENTAL DISCHARGES OVER THE EMBANKMENT FOR SUCCESSIVE RESERVOIR ELEVATIONS ARE APPROXIMATELY TRAPEZOIDAL IN CROSS-SECTIONAL FLOW AREA. THEN ANY INCREMENTAL AREA OF FLOW CAN BE ESTIMATED AS $H_i [(L_1+L_2)/2]$, WHERE L_1 = LENGTH OF EMBANKMENT OVERTOPPED AT HIGHER ELEVATION, L_2 = LENGTH AT LOWER ELEVATION, H_i = DIFFERENCE IN ELEVATIONS. THUS, THE TOTAL AVERAGE "FLOW AREA WEIGHTED HEAD" CAN BE ESTIMATED AS

H_w = (TOTAL FLOW AREA / L_1).

EMBANKMENT RATING TABLE:

RESERVOIR ELEVATION (FT)	L_1 (FT)	L_2 (FT)	INCREMENTAL HEAD, H_i (FT)	① INCREMENTAL FLOW AREA, A_i (FT^2)	TOTAL FLOW AREA, A_T (FT^2)	② WEIGHTED HEAD, H_w (FT)	③ H_w/l	④ C	⑤ Q (CFS)
1197.1	70	–	–	–	–	–	–	–	0
1197.2	110	70	0.1	9	9	0.08	0.01	2.92	10
1197.3	205	110	0.1	16	25	0.12	0.02	2.94	30
1197.5	250	205	0.2	46	71	0.28	0.04	2.99	110
1198.0	295	250	0.5	136	207	0.70	0.10	3.01	520
1199.0	340	295	1.0	318	525	1.5	0.21	3.08	1920
1200.0	360	340	1.0	350	875	2.4	0.34	3.09	4140

① $A_i = H_i [(L_1+L_2)/2]$
② $H_w = A_T / L_1$
③ l = BREADTH OF CREST = 7 FT (FIELD MEASURED)
④ $C = f(H, l)$; FROM REF 12, FIG 24.
⑤ $Q = C L_1 H_w^{3/2}$ (ROUNDED TO NEAREST 10 CFS)

SUBJECT DAM SAFETY INSPECTION
LONG RIDGE DAM

BY DJS DATE 6-11-81 PROJ. NO. 80-238-022

CHKD. BY DLB DATE 6-24-81 SHEET NO. 10 OF 10

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TOTAL FACILITY RATING TABLE

$Q_{TOTAL} = Q_{SPILLWAY} + Q_{EMBANKMENT}$

RESERVOIR ELEVATION (FT)	① $Q_{SPILLWAY}$ (CFS)	② $Q_{EMBANKMENT}$ (CFS)	Q_{TOTAL} (CFS)
1195.0	0	–	0
1195.7	20	–	20
1196.4	80	–	80
1197.0	170	–	170
(TOP OF DAM) 1197.1	190 *	0	190
1197.2	210 *	10	220
1197.3	230 *	30	260
1197.5	270	110	380
1198.0	400	520	920
1199.0	690 *	1920	2610

* – INTERPOLATED FROM RATING TABLE – SHEET 7.
(ROUNDED TO NEAREST 10 CFS)

① FROM SHEET 7.

② FROM SHEET 9.

SUBJECT DAM SAFETY INSPECTION

LONG RIDGE DAM

BY DTS DATE 7-2-81 PROJ. NO. 80-238-022

CHKD. BY DLB DATE 8-12-81 SHEET NO. 4 OF 6

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OVERTOPPING ANALYSIS:

SUMMARY INPUT/OUTPUT SHEETS

```
DAM SAFETY INSPECTION
10-MINUTE TIME STEP AND 48-HOUR STORM DURATION
LONG RIDGE DAM **** OVERTOPPING ANALYSIS ****

                    JOB SPECIFICATION
 NQ      NDR     NMIN     IDAY      IHR     IMIN    METRC     ITPLT     IPRT    NSTAN
288       0       10        0        0        0        0         0        0        0
                          JOPER      NWT   LKOPT   TRACE
                              5        0       0       0


              MULTI-PLAN ANALYSES TO BE PERFORMED
                  NPLAN= 1 NRTIO= 4 LRTIO= 1
 RTIOS=     .50     .60     .70    1.00


**********          **********          **********          **********          **********

                SUB-AREA RUNOFF COMPUTATION

     RESERVOIR INFLOW

                 ISTAO   ICOMP   IECON   ITAPE    JPLT    JPRT   INAME  ISTAGE   IAUTO
                     1       0       0       0       0       0       1       0       0

                    HYDROGRAPH DATA
     IHYDG    IUHG   TAREA    SNAP   TRSDA   TRSPC   RATIO  ISNOW   ISAME   LOCAL
         1       1     .10    0.00     .10    0.00   0.000      0       1       0

                      PRECIP DATA
          SPFE     PMS      R6      R12     R24     R48     R72     R96
          0.00   22.00  111.00  123.00  133.00  142.00    0.00    0.00
TRSPC COMPUTED BY THE PROGRAM IS  .800

                      LOSS DATA
 LKOPT   STRKR   DLTKR   RTIOL   ERAIN   STRKS   RTIOK   STRTL   CNSTL   ALSMX   RTIMP
     0    0.00    0.00    1.00    0.00    0.00    1.00    1.00     .05    0.00    0.00

                   UNIT HYDROGRAPH DATA
                TP=    .48    CP= .45    RTA=  0

                   RECESSION DATA
          STRTQ=   -1.50    QRCSN=    -.05    RTIOR= 2.00
APPROXIMATE CLARK COEFFICIENTS FROM GIVEN SNYDER CP AND TP ARE TC= 1.15 AND R= 1.32 INTERVALS

     UNIT HYDROGRAPH 25 END-OF-PERIOD ORDINATES, LAG=    .48 HOURS, CP=  .45  VOL= 1.00
  10.     36.     58.     58.     47.     37.     29.     23.     18.     15.
  12.      9.      7.      6.      5.      4.      3.      2.      2.      1.
   1.      1.      1.      1.      0.
```

INITIAL & CONSTANT RAINFALL LOSSES AS PER C.O.E.

BASE FLOW PARAMETERS AS PER C.O.E.

	RAIN	EXCS	LOSS	COMPQ
SUB	24.99	22.60	2.39	8662.
	(635.)(	574.)(	61.)(	245.05)

SUBJECT DAM SAFETY INSPECTION

LONG RIDGE DAM

BY JTS DATE 7-2-81 PROJ. NO. 80-238-022

CHKD. BY DLB DATE 8-12-81 SHEET NO. 8 OF 5

GAI CONSULTANTS, INC.

Engineers • Geologists • Planners
Environmental Specialists

RESERVOIR INFLOW HYDROGRAPHS

0.5PMF

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	713.	98.	30.	15.	4349.
CMS	6.	3.	1.	0.	123.
INCHES		9.08	11.03	11.24	11.24
MM		230.71	280.27	285.44	285.44
AC-FT		48.	59.	60.	60.
THOUS CU M		60.	73.	74.	74.

0.6PMF

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	256.	117.	36.	18.	5219.
CMS	7.	3.	1.	1.	148.
INCHES		10.90	13.24	13.49	13.49
MM		276.85	336.33	342.53	342.53
AC-FT		58.	71.	72.	72.
THOUS CU M		72.	87.	89.	89.

0.7PMF

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	299.	137.	42.	21.	6089.
CMS	8.	4.	1.	1.	172.
INCHES		12.72	15.45	15.73	15.73
MM		323.00	392.38	399.61	399.61
AC-FT		68.	82.	84.	84.
THOUS CU M		84.	102.	103.	103.

PMF

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	427.	195.	59.	30.	8698.
CMS	12.	6.	2.	1.	246.
INCHES		18.17	22.07	22.48	22.48
MM		461.42	560.55	570.88	570.88
AC-FT		97.	118.	120.	120.
THOUS CU M		119.	145.	148.	148.

********** ********** ********** ********** ********** **********

HYDROGRAPH ROUTING

ISTAO	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME	ISTAGE	IAUTO
101	1	0	0	0	0	1	0	0

ROUTING DATA

QLOSS	CLOSS	AVG	IRES	ISAME	IOPT	IPMP	LSTR
0.0	0.000	0.00	1	1	0	0	0

NSTPS	NSTDL	LAG	AMSKK	X	TSK	STORA	ISPRAT
1	0	0	0.000	0.000	0.000	-1195.	-1

STAGE	1195.00	1195.70	1196.40	1197.00	1197.10	1197.20	1197.30	1197.50	1198.00
FLOW	0.00	20.00	80.00	170.00	190.00	220.00	260.00	380.00	920.00
SURFACE AREA=		0.	9.	13.	18.				
CAPACITY=		0.	30.	53.	97.				
ELEVATION=		1185.	1195.	1197.	1200.				

CREL	SPWID	COOR	EXPW	ELEVL	COOL	CAREA	EXPL
1195.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

DAM DATA

TOPEL	COOD	EXPD	DAMWID
1197.1	0.0	0.0	0.

SUBJECT DAM SAFETY INSPECTION

LONG RIDGE DAM

BY BJS DATE 7-2-81 PROJ. NO. 80-238-022

CHKD. BY DLB DATE 8-12-81 SHEET NO. 5 OF 5

Engineers • Geologists • Planners
Environmental Specialists

GZA CONSULTANTS, INC.

RESERVOIR OUTFLOW HYDROGRAPHS

0.5PMF

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	139.	66.	27.	14.	4022.
CMS	4.	2.	1.	0.	114.
INCHES		7.99	10.23	10.39	10.39
MM		203.02	259.90	264.01	264.01
AC-FT		49.	55.	55.	55.
THOUS CU M		53.	67.	68.	68.

0.6 PMF

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	170.	105.	33.	17.	4667.
CMS	5.	3.	1.	0.	132.
INCHES		9.74	12.38	12.58	12.58
MM		247.37	314.52	319.45	319.45
AC-FT		52.	66.	67.	67.
THOUS CU M		64.	81.	83.	83.

0.7PMF

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	211.	124.	39.	20.	5713.
CMS	6.	3.	1.	1.	162.
INCHES		11.49	14.54	14.76	14.76
MM		291.93	369.22	374.97	374.97
AC-FT		61.	77.	79.	79.
THOUS CU M		75.	96.	97.	97.

PMF

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	361.	181.	57.	29.	8200.
CMS	10.	5.	2.	1.	234.
INCHES		16.85	21.04	21.36	21.36
MM		427.87	534.30	542.52	542.52
AC-FT		90.	112.	114.	114.
THOUS CU M		111.	138.	140.	140.

********** ********** ********** ********** **********

SUMMARY OF DAM SAFETY ANALYSIS

	INITIAL VALUE	SPILLWAY CREST	TOP OF DAM
ELEVATION	1195.00	1195.00	1197.10
STORAGE	30.	30.	53.
OUTFLOW	0.	0.	190.

RATIO OF PMF	MAXIMUM RESERVOIR W.S.ELEV	MAXIMUM DEPTH OVER DAM	MAXIMUM STORAGE AC-FT	MAXIMUM OUTFLOW CFS	DURATION OVER TOP HOURS	TIME OF MAX OUTFLOW HOURS	TIME OF FAILURE HOURS
.50	1196.79	0.00	49.	139.	0.00	40.83	0.00
.60	1197.00	0.00	52.	170.	0.00	40.83	0.00
.70	1197.17	.07	54.	211.	.83	40.67	0.00
1.00	1197.47	.37	58.	361.	4.33	40.50	0.00

OVERTOPPING OCCURS @ ≥ 0.65PMF

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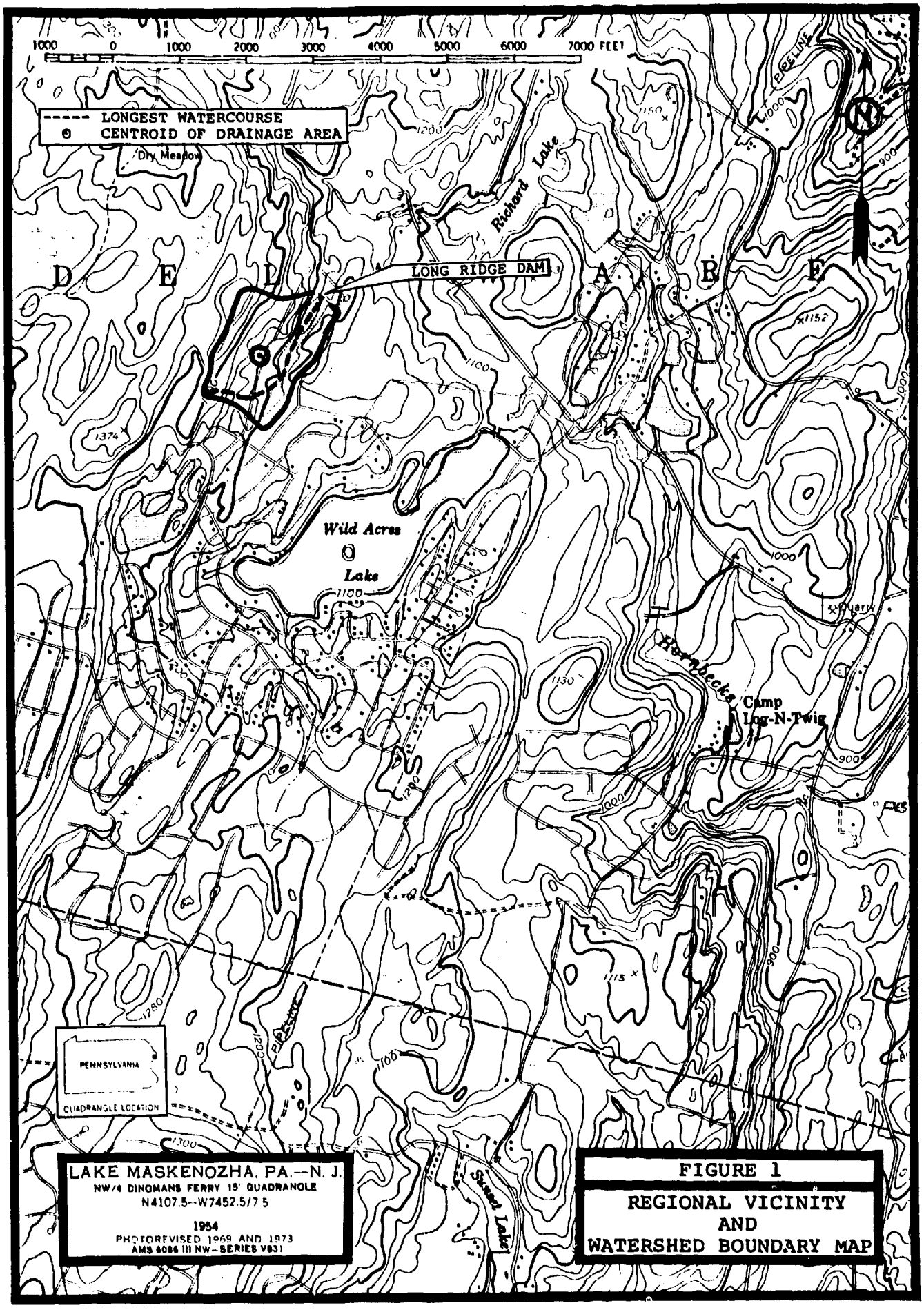
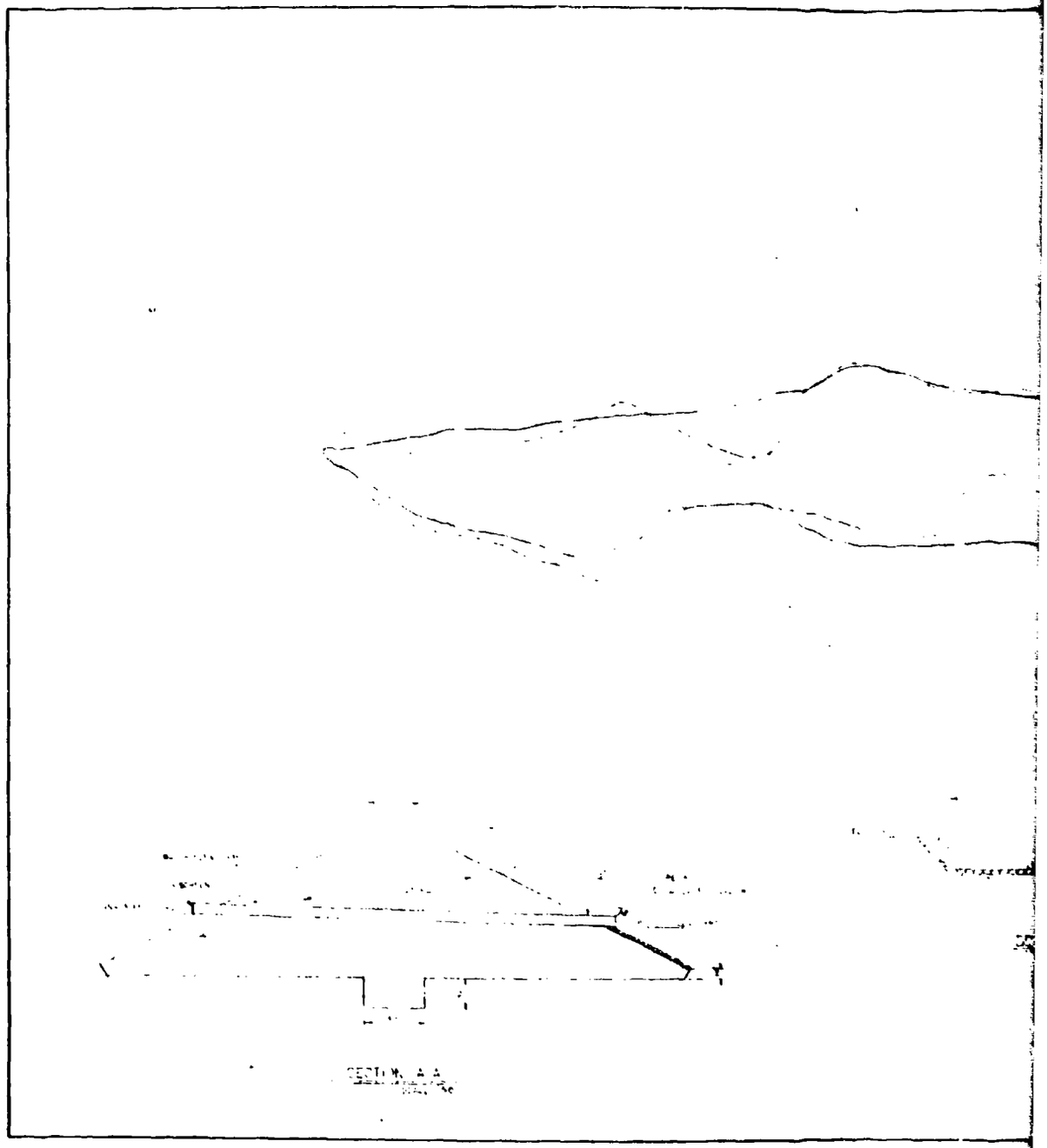
APPENDIX E

FIGURES

LIST OF FIGURES


1000 0 1000 2000 3000 4000 5000 6000 7000 FEET
----- LONGEST WATERCOURSE
⊙ CENTROID OF DRAINAGE AREA
Dry Meadow
Richard Lake
LONG RIDGE DAM
D E L A W A R E
Wild Acres Lake
Camp Log-N-Twig
PENNSYLVANIA
QUADRANGLE LOCATION
LAKE MASKENOZHA, PA.--N. J.
NW/4 DINGMANS FERRY 15' QUADRANGLE
N4107.5--W7452.5/7 5
1954
PHOTOREVISED 1969 AND 1973
AMS 6066 III NW-SERIES V831
Speed Lake
FIGURE 1
REGIONAL VICINITY
AND
WATERSHED BOUNDARY MAP



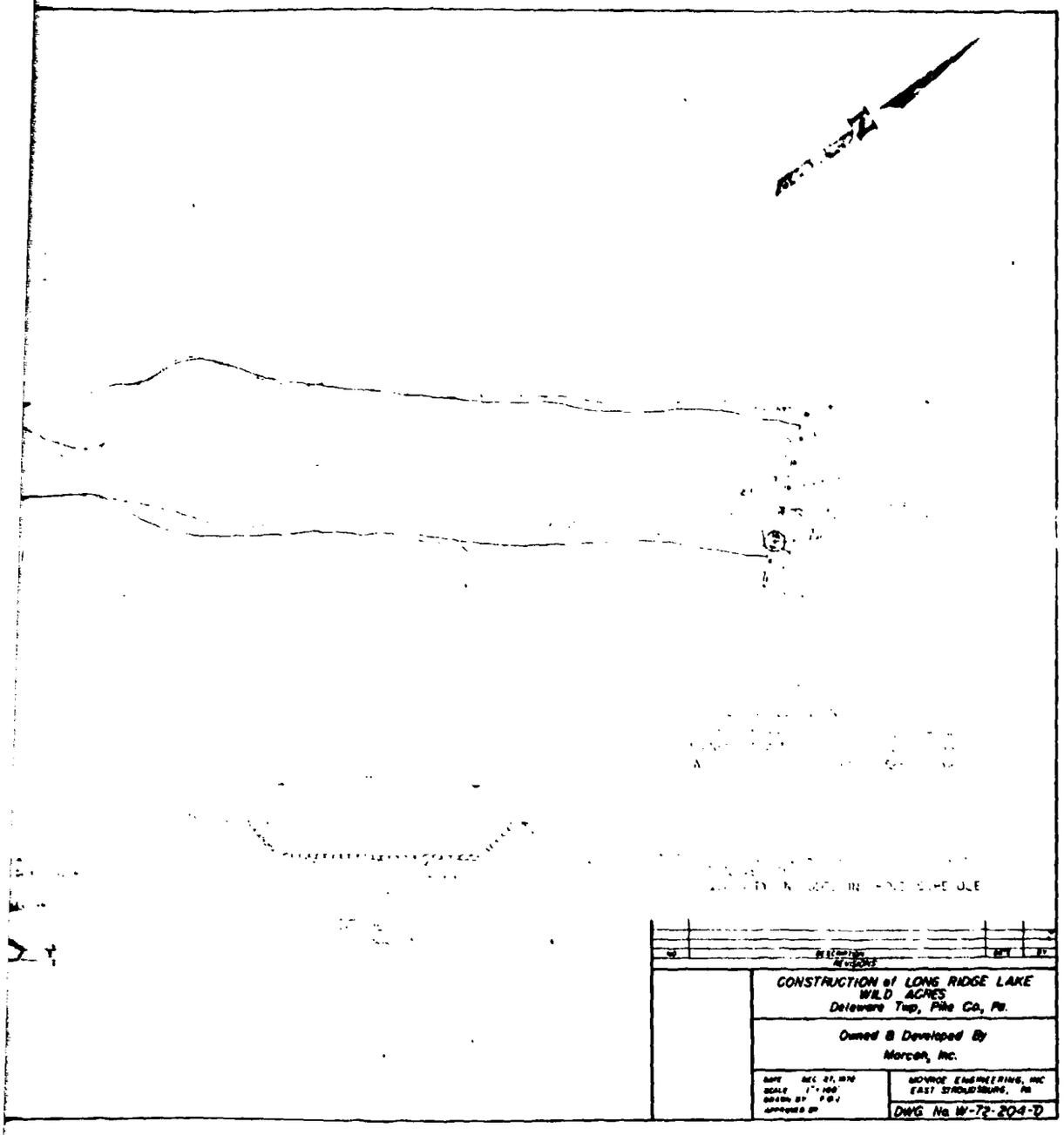


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FIGURE 2

APPENDIX F

GEOLOGY

Geology

Long Ridge Dam is located in the glaciated Low Plateaus section of the Appalachian Plateaus physiographic province of eastern Pennsylvania. In this area, the Appalachian Plateaus province is characterized topographically by flat-topped, hummocky hills formed as a result of glaciation and subsequent stream dissection of nearly flat-lying strata. The Devonian age sedimentary rock strata in Pike County regionally strike N35½E and dip gently to the northwest. The Delaware River is the major drainage basin in the area. Major tributary streams intersect the Delaware River at right angles; whereas, smaller streams display a slightly more random tributary pattern. Both major and minor tributary stream systems are joint controlled and exhibit modified rectangular and trellis-type drainage patterns.

Structurally, the area containing Pike County lies on the south flank of a broad, asymmetrical synclinorium that plunges to the southwest. Superimposed on this broad structural basin are numerous anticlinal and synclinal folds characterized by planar limbs and narrow hinges. Due to prior glaciation, low relief and surficial soil cover, fold axes are difficult to trace.

The sedimentary rock sequences in the vicinity of the dam and reservoir are probably members of the Susquehanna Group of Upper Devonian age (see Geology Map). The sedimentological changes observed in the Catskill Formation indicate that the rate of sedimentation exceeded the rate of basin subsidence resulting in a facies change from marine to non-marine strata. On the accompanying geology map the delineation between the Middle and Upper Devonian age sedimentary rock sequences represents the Allegheny Front which separates the Valley and Ridge physiographic province from the Appalachian Plateaus physiographic province.

Approximately half of Pike County, including the dam site, is covered by a blanket of Wisconsin age (most recent) glacial drift which, based on the degree of weathering, was probably deposited during the Woodfordian stage. Valley bottoms are typically covered by recent alluvium and Woodfordian outwash of variable thickness, but typically less than 10 feet. These deposits are characteristically unconsolidated stratified sand and gravel, usually with more gravel than sand and some small boulders. The direction of the Wisconsin ice advance was from the northeast over the Catskill Mountains and from the north over the Appalachian Plateau. The terminal moraine resulting from the southern most advance of the Wisconsin ice sheet in this area is located in the southern portion of Monroe County which borders Pike County to the South.

References:

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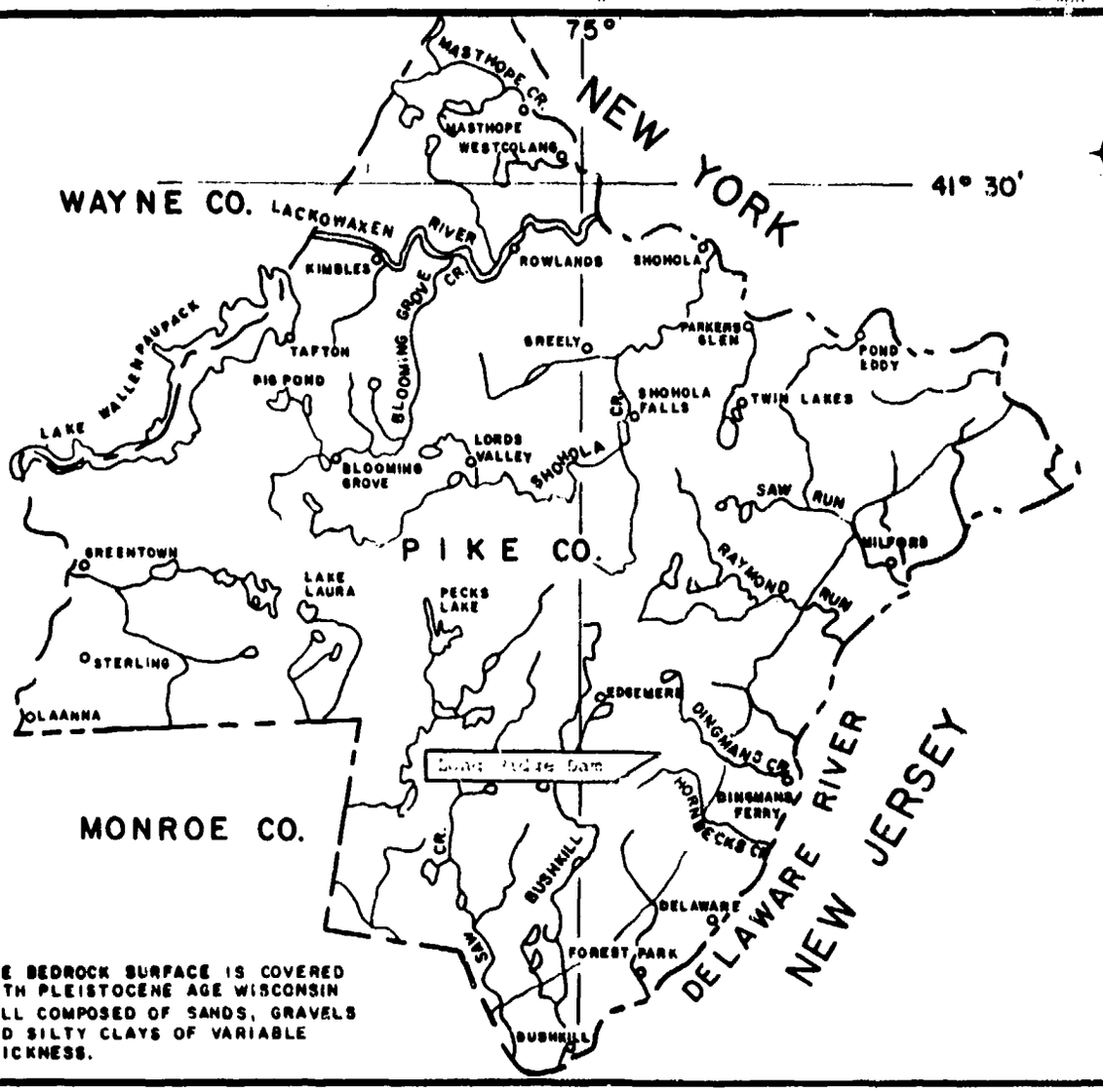

NOTE: THE BEDROCK SURFACE IS COVERED WITH PLEISTOCENE AGE WISCONSIN TILL COMPOSED OF SANDS, GRAVELS AND SILTY CLAYS OF VARIABLE THICKNESS.

LEGEND

UPPER DEVONIAN

SUSQUEHANNA GROUP

Catskill Formation - *Shohola Member interbedded 5- to 25-foot thick units of greenish-gray and greyish-red very fine to medium-grained sandstone and sandy shale and lesser medium-gray to medium-dark-gray sandstone and shale. Sandstones are predominantly low-rank graywackes. Beds are thin to very thick and most have simple or planar sets of small- to medium-scale, generally low-angle cross stratification. Contacts with shale units are abruptly disconformable to gradational. Sandstones are poorly cleaved. Shale is thinly laminated and well cleaved. Mud cracks, convolute bedding, and ripple marks are present near contacts with sandstone units. Member is more than 2,000 feet thick. Lower contact is gradational and is placed at top of highest red bed of the underlying Analomink. Analomink Red Shale Member, medium-greyish red silty, micaceous, finely laminated well-cleaved shale containing thin beds of brownish-gray sandy siltstone and silty very fine grained sandstone. Unit is the "first red" going up section in Upper Devonian sequence. member is about 100 feet thick. Lower contact is gradational and is placed at the base of lowest red bed. Delaware River Flags Member, grayish-green, micaceous, laminated sandstone and lesser interbedded sandy shale. Beds range from a few inches to as much as 4 feet thick. Sandstones are low-rank graywackes and contain no marine fossils. Member is about 300 feet thick. Lower contact is gradational.*

MIDDLE DEVONIAN

HAMILTON GROUP

Mahantango Formation - *Upper member medium-dark-gray, fairly coarse grained, thin-bedded siltstone and silty shale; member in about 700 feet thick and is separated from lower member by the "Centerfield Reef," a calcareous siltstone bioutreme containing abundant horn corals. The Centerfield is about 25 feet thick, lower member, virtually same lithology as upper member. Unit is about 1,100 feet thick. Lower contact is gradational.*

Marcellus Shale - *Dark-gray, evenly laminated, silty clay shale and clayey silt shale. Unit commonly contains very hard limy concretions and is well cleaved; bedding is generally obscured. Member is about 75-feet thick. Lower contact is gradational.*

SCALE

0 6 12 18 MILES

REFERENCE:

GEOLOGIC MAP OF NORTHEASTERN PENNSYLVANIA COMPILED BY GEO. W. STOSE AND O. A. LJUNGSTEDT COMMONWEALTH OF PENNSYLVANIA DEPT. OF INTERNAL AFFAIRS DATED 1932, SCALE 1" = 6 MILES

GEOLOGY MAP

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